Particles and Fields—Ionosphere

5530 High-latitude ionospheric currents
CHATANIKA RADAR OBSERVATIONS RELATING TO THE LATITUDINAL AND LOCAL TIME VARIATIONS OF JOULE HEATING
F. H. Banks (Center for Atmospheric and Space Sciences, Utah State University, Logan, Utah 84322) J. C. Foster and J. R. Doupnik

Observations of plasma convection made with the Chatanika incoherent scatter radar have been analyzed to give latitude/local time plots of the electric field contribution (E') to thermospheric Joule heating. The data, which span the latitude range 58° to 75°Λ, show the presence of strong heating throughout the auroral regions. Of special interest are brief interludes of intense heating (> 50 mW m⁻²) which are observed at nearly all local times and latitudes in response to magnetospheric disturbances. Further, there seem to be particular regions of the auroral oval where Joule heating seems to be continually enhanced above the broad background. The results of six 24 hour experiments are presented to illustrate summer (5) and winter conditions (1). A shorter eight hour experiment is also given to show the characteristics of cleft heating, insofar as they are visible to the Chatanika radar.
J. Geophys. Res., Blue, Paper 1A0999

5535 Interactions between waves and particles
DIFFUSION OF SMALL-SCALE DENSITY IRREGULARITIES DURING EQUATORIAL SPREAD F
J.D. Huba and S.L. Ossakow (Naval Research Laboratory, 4555 Overlook Avenue, S.W., Washington, D.C. 20375)

The diffusion of small-scale density irregularities (i.e., those with density gradient scale lengths less than several hundred meters) is investigated during the decay phase of equatorial spread F. Both classical and anomalous diffusion processes are considered. The anomalous diffusion coefficient is based upon the transport properties associated with the universal drift instability. It is found that anomalous diffusion can smooth out small-scale density irregularities on time scales, τ, consistent with observational results, i.e., few minutes to a few hours. On the other hand, classical diffusion is much too slow a process to be important. However, anomalous diffusion is unable to diffuse large-scale irregularities, i.e., those with scales lengths greater than a kilometer, on time scales τ ≤ few hours and another mechanism must occur to smooth out these irregularities, e.g., shorting out to the E region.
J. Geophys. Res., Blue, Paper 1A0940

5545 Ionospheric disturbances
MAGNETIC STORM ASSOCIATED ENHANCED PARTICLE PRECIPITATION IN THE SOUTH ATLANTIC ANOMALY: EVIDENCE FROM VLF PHASE MEASUREMENTS
M. A. Abdu (Instituto de Pesquisas Espaciais, Conselho Nacional de Desenvolvimento Cientifico e Tecnológico, 12200 São José dos Campos, S.P., Brazil) I. S. Batista and L. R. Piazza, O. Mascarenhas (Instituto de Astronomia e Geofisica, Universidade de São Paulo)

Phase recordings at Atibaia, Brazil, (23°S, 46°W) of 13.6 KHz VLF signal transmitted from Golfo Nuevo, Argentina (43°S, 65°W), a trajectory confined almost completely within the South Atlantic Anomaly region, show significant perturbations, indicative of the lowering of the VLF reflection level, following the onset of magnetic disturbances. Simultaneous measurements of the Es-layer parameters, f_oE_s and f_bE_s, over Cachoeira Paulista (22°S, 45°W) also show enhancements, with some delay with respect to the magnetic disturbance onset, as was found in our earlier work (Batista and Abdu, 1977). These results show magnetic storm associated ionization enhancements taking place in a height region from approximately 110 km down to 70 km, which we interpret as having been produced by precipitation of high energy charged particles in the South Atlantic Magnetic Anomaly. The results also suggest some degree of day to day variability in the abundance of metallic species, and/or in the dynamics of the E region over this region.
J. Geophys. Res., Blue, Paper 1A0951

5545 Ionospheric disturbances
IONOSPHERIC SCINTILLATION OBSERVATIONS AT NATAL
K.C. Yeh (Department of Electrical Engineering, University of Illinois, Urbana, IL 61801, U.S.A.) J.P. Mullen, J.R. Medeiros, R.F. da Silva and R.T. Medeiros

In this paper we report ionospheric scintillation observations made at Natal, Brazil during a period of 2½ years. The nighttime scintillations of satellite signals at 250 MHz commonly exceeded 20 decibels peak-to-peak. Seasonally, it showed a typical behavior for the South American sector with a single peak centered around October-November months and the local evening hours of 2100-2300 LMT. This seasonal behavior was different from that of the African sector and very different from the Pacific sector. On a spacing of 278 meters, the eastward irregularity drift speed was measured by the method of similar fades. This together with the determination of Fresnel frequency from the power spectrum analysis was used to calculate the height of the irregularity patch. A value of 294 km was obtained. Multi-satellite scintillation observations indicated that even though the initiation of an irregularity cloud commonly occurred earlier on signals transmitted by the eastern satellite, there were substantial cases when the reverse was observed. One case which was analyzed in detail suggested that the irregularity clouds formed independently along two radio paths separated by 520 km. (Equatorial ionosphere, radio wave scattering).
J. Geophys. Res., Blue, Paper 1A0611

5545 Ionospheric disturbances
THE OCCURRENCE OF NIGHTTIME VHF SCINTILLATIONS NEAR EQUATORIAL ANOMALY CREST IN THE INDIAN SECTOR
A. DasGupta (Air Force Geophysics Laboratory/PHY, Hanscom Air Force Base, MA 01731) A. Maitra and Santimay Basu

The behavior of nighttime F-region irregularities near the northern crest of the equatorial anomaly in the Indian sector has been investigated by using VHF amplitude scintillation measurements made at Calcutta (27°N dip subionospheric) during the period April, 1977 through February, 1980. With the increase in solar activity the occurrence of scintillations increases remarkably during the equinoxes and to a lesser extent during the December solstice, while the local summer occurrence shows little change. The observed patterns are assessed in terms of the variation of the F-layer height with solar activity and upwelling motion of the depleted flux tubes associated with small scale irregularities. It is shown that the propagation path is more likely to intercept these equatorial irregularities during periods of high solar activity, while during periods of low solar activity the equatorial irregularities lie south of the propagation path. (Scintillations, equatorial irregularities).
Rad. Sci., Paper 1S0912

Particles and Fields—Magnetosphere

5715 Electric fields
AN S3-3 SEARCH FOR CONFINED REGIONS OF LARGE PARALLEL ELECTRIC FIELDS
H. H. Boehm (Space Sciences Laboratory and Physics Department, University of California, Berkeley, California 94720) F. S. Mozer

Electrostatic shocks observed previously on the S3-3 satellite all have electric fields primarily perpendicular to the magnetic field, while the double layers observed in the laboratory and in computer simulations generally involve a mode whose electric field would be parallel to the magnetic field in the magnetized case. Since parallel potentials are known to exist in association with the perpendicular shocks, electric field data from the S3-3 satellite were searched for mostly parallel fields of hundreds of millivolts per meter. The data set consisted of auroral zone passes containing 207 perpendicular shocks, which were used in previous statistical studies, plus 40 additional orbits. At most a few events were found. Hence upper limits are placed on the number and size of double layer structures associated with perpendicular shocks. For most reasonable sets of parameters, the double layer structures cannot be greater than roughly 3 km in latitudinal extent when mapped to the ionosphere. (Double layers, electric fields, electrostatic shocks).
Geophys. Res. Lett., Paper 1L0798

5755 Plasma instabilities
THE SIGNIFICANCE OF TEMPERATURE IN A FINITE GEOMETRY BEAM-PLASMA SYSTEM
R. J. Strangeway (Cooperative Institute for Research in Environmental Sciences, University of Colorado/NOAA, Boulder, CO 80309)

A cold plasma approximation is often employed when deriving a wave dispersion relation for a beam-plasma system in which the beam width is considered to be a factor in the wave dispersion. This approximation may no longer be valid for a sufficiently thin beam whose width is comparable to the Larmor radius and temperature should be included in the model. As an initial attempt to take into account warm plasma effects we treat temperature as a first order correction to the cold dispersion relation. Temperature dependent wave fields are found for solutions of the cold modal dispersion relation and we choose to present solutions for frequencies above the electron gyro-frequency when the electron plasma frequency is greater than the electron gyro-frequency. Since temperature enters as a correction term, some knowledge of the wave field eigenfunctions is required, and one example of both the cold modal fields and the temperature corrections to these fields is given. Determining the form of the wave eigenfunctions is also a useful indicator of how electrostatic the waves are, which is of some importance in simplifying a finite geometry warm plasma dispersion relation. By comparing the correction fields to the cold modal fields it is possible to determine a critical thermal velocity for which the temperature corrections become significant. A temperature of .25eV for a 2.5 keV electron beam is shown to be a reasonable limit for the validity of a cold plasma approximation. Since the temperature is not just a beam temperature, but also a background plasma temperature, this result may have implications for both magnetospheric and laboratory electron beam instabilities.
J. Geophys. Res., Blue, Paper 1A0946

Looking for a Change of Climate? Computers Make Long-Time Comparisons Possible

C. J. Posey
University of Connecticut, Storrs

With the increasing mobility of our population, climate is becoming more of a factor in deciding where to look for a new job or a good place for retirement. If a new location turns out to be no improvement, the young can try another one. The elderly must be more careful. The place they liked best during vacations may not be so good during the rest of the year.

By noticing news media reports of temperatures and precipitation, one can gain some idea of the weather at various locations in the United States. To take into account the many other elements that affect individual preferences, trial residence for a whole year would seem to be necessary (difficult to arrange for most of us). Even this might not be enough, for there are both good years and bad years everywhere.

There is a widespread belief that certain areas of the country have a more equable climate than others. To attract people who dislike rapid temperature changes, some localities claim to have the most equable climate anywhere. To see how great the differences can be, we selected two cities for which the contrast should be extreme: Minneapolis and San Francisco. Minneapolis is near the middle of the great North American plain, while San Francisco is on the edge of the vast expanse of the Pacific Ocean. Records of Fahrenheit thermometer readings taken hourly at these stations for the 10 years from January 1, 1949, to December 31, 1959, were available to provide the data for an objective comparison. The 87,600 readings at each station were analyzed with the aid of the University of Connecticut's digital computer.

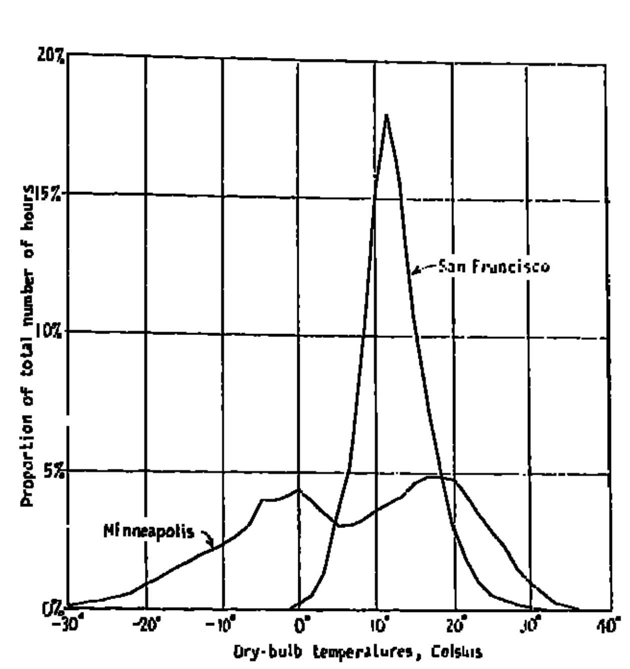

Fig. 1. Frequency of various temperatures, as recorded hourly during 10-year period 1949–1959. (Lines connect points plotted at centers of class intervals 3° F wide.)

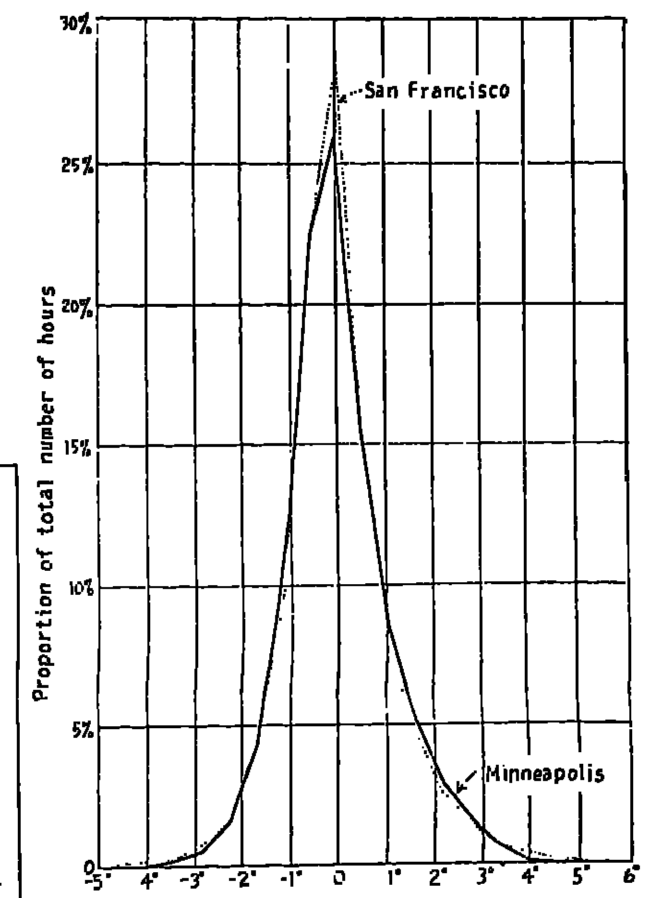

Fig. 2. Frequency of hour-to-hour temperature changes. (Lines connect points plotted at centers of 1° F class intervals.)

The seasonal ranges of temperature for both stations are shown on Figure 1. Those who suffer when temperatures go below freezing will seldom be discomforted in San Francisco, while those who remain in Minneapolis will experience such temperatures more than one third of the time. On the other hand, Minneapolis has temperatures above 18° C (65° F), necessary for growing certain crops, nearly three times as many hours as does San Francisco. Study of Figure 1 alone can lead a person to conclude that San Francisco has the more equable climate.

An equable climate, however, is one where temperature *changes* are small, never large. To evaluate the difference in this respect, the successive changes in the 87,600 hours were obtained and the percentage of each different size hour-to-hour change computed. Figure 2 shows the results. In marked contrast with the differences shown in Figure 1, those in Figure 2 are barely perceptible. Examination of the computer printouts shows that during this particular 10-year period changes of more than 6° F (3 ½° C) per hour were very infrequent but were slightly more common in San Francisco than in Minneapolis. Despite the great difference in the yearly patterns of temperatures, these two cities evidently have almost equally equable climates.

It seems likely that a comparison of data from other stations will lead to the same conclusion. A previous study, based on a much smaller body of data, showed that the climates at stations varying in latitude from 24°N to 48°N were nearly equable. Aside from the regular diurnal effects, temperature changes come from the large-scale atmospheric turbulence, which travels everywhere, making difficulties for the weather forecasters.

If weather is indeed a major consideration in picking a new location for work or retirement, one must go beyond listening to claims of 'equable weather.' Records of temperatures, precipitation, humidity, hours of sunshine, and air quality are available from the National Records Center, Beltsville, Maryland. It is well to keep in mind, moreover, that cost of living and sociological considerations (more changeable than the weather?) are likely to turn out to be most important.

Chesley J. Posey is emeritus professor of civil engineering at the University of Connecticut, Storrs. Structural engineering experience led him into reinforced concrete research and then to association with S. M. Woodward, with whom he authored a text on hydraulics of open channel flow. Collaboration with R. W. Powell at the Rocky Mountain Hydraulic Laboratory produced a large-scale study of open channel friction. Together with several other AGU members he assisted T. H. Wiggin in the preparation of AWWA's 'Spillway Design Practice.' His current research interests are erosion protection and the 'signatures' of random time series.

EOS

TRANSACTIONS, AMERICAN GEOPHYSICAL UNION

The Weekly Newspaper of Geophysics

Send double-spaced manuscripts (four copies) to *Eos*, AGU, 2000 Florida Avenue, N.W., Washington, D.C. 20009, or send them directly to one of the associate editors with a copy to the above address.

Eos, Transactions, American Geophysical Union (ISSN 0096-3941) is published weekly by the American Geophysical Union from 2000 Florida Avenue, N.W., Washington, D. C. 20009. Subscription available on request. This issue $5.00. Second-class postage paid at Washington, D. C., and at additional mailing offices.

Cover. The May 18, 1980, eruption of Mt. St. Helens was observed by SWIR sensors aboard two U.S. Air Force satellites. The data reveal a complex sequence of events following initiation of the eruption at 8:32 PDT (15:32 UT), as described on page 577 of this issue. Immediately following the triggering landslide, a large cloud of ash was propelled toward the east and northeast at a speed of about 100 m/s, while hotter material was being evolved along the north flank of the mountain. The figures on the cover delineate the largest lateral blast, which began at about 15:34:50 UT, about 2½ min into the eruption. The surge moved northward along the track shown in the left figure (tick marks at 10-km intervals). The boundary of the zone of destruction is shown for orientation. The two figures to the right show the distance traveled (top) and the speed of the surge as a function of time. The initial velocity was about 450 m/s. The fan-shaped surge split the previously evolved ash into two parts, propelling them eastward and westward at velocities of 150–250 m/s. Emission of extremely hot ash at the crater itself was terminated with the blast and did not resume until 6–7 min later, at which time copious vertical emission began. (For more information, see news item, pg. 577.)

News

Satellite Observations of Mt. St. Helens

The major eruption of Mt. St. Helens on May 18, 1980, was recorded by infrared sensors aboard two U.S. Air Force satellites. The extent of the coverage and the completeness of the data base appear to be unique, providing information unavailable from other sources. The eruption was monitored essentially continuously, beginning at 15:32:57 UT, less than 1 min after the earthquake that appears to have been the triggering event. Dual satellite monitoring permits triangulation, so that both the lateral and vertical development of the ash emission can be determined with good temporal resolution. The data are being analyzed at the Space Sciences Laboratory of The Aerospace Corporation. Emphasis up to now has been placed on elucidating the sequence of events during the highly dynamic early eruptive phase, principally the period between initiation and the first GOES photograph at 15:45 UT. The resulting picture differs in many important respects from that inferred from photographs made by nearby observers, or from indirect evidence such as blast effects. The nature and timing of the principal events have been described in a report to the Society of Photo-optical Instrumentation Engineers (SPIE) Washington meeting and are summarized below.

The earliest eruption period was characterized by a complex sequence of emissions. At first only relatively cool material (T < 400 K) was evolved; part of this material moved toward the east and northeast at speeds of about 100 m/s. At about 15:33:10, the first of at least three separate emissions of hot material, with surface temperatures of 500 K or higher, occurred. None of these ejections, nor the earlier cooler material, exceeded an altitude of 6 km. Thus, although a great deal of hot material had been emitted, it was confined primarily to the northern face of the mountain and the southern portion of Spirit Lake prior to about 15:34:50 UT. It was at this time, and not immediately following the initial landslide, that the principal destructive surge or lateral blast occurred. A fan-shaped mass of ash (~ 40°–50°) was propelled northward away from the mountain with an initial velocity of about 450 m/s (i.e., probably as a shock wave propagating at acoustic velocity in the air heated to 500 K by the hot ash). It appears that the previously evolved material was split by the surge and driven eastward and westward at velocities of 150–250 m/s or greater. The rapid expansion phase lasted less than half a minute and was followed by a period of lower velocities that reached to the boundaries of the zone of total timber destruction by about 15:37 UT. Coincident with the blast, the crater itself stopped emitting significant quantities of hot ash for some 6–7 min. Just prior to 15:42 UT, hot ash began spewing vertically from the crater, producing the high ash column that was to be the dominant feature of the succeeding eruption period. Although the collapse of the southern crater wall could not be monitored directly, it appears probable that it occurred primarily during this period between 15:35 and 15:42 UT. The majority of the ash was injected into two layers, one at a peak altitude of 18–21 km, moving eastward at about 12 m/s, and the other, larger mass at 12–15-km altitude, where the prevailing eastward wind had a velocity of about 31 m/s. There were also two discrete plumes which carried much less material but reached considerably higher altitudes. The first of these was produced by the major explosion at about 15:35; after rising through the atmosphere at about 40 m/s, it stabilized, by 15:50 UT, at a peak altitude of about 24–27 km. The direct cause of the second high-altitude plume is more difficult to determine, since it appears to have originated just north of the destruction zone itself and as late as perhaps 15:42 UT. This plume reached a peak altitude of 29–32 km by about 16:00 UT; no material ejected subsequently reached so high an altitude. The ambient winds between 24 and 32 km were very light, with the result that these plumes evolved internally but did not move rapidly away.

Both plumes and the two principal tower-altitude ash layers can be distinguished in the widely circulated GOES-West image for 16:15 UT.

The new data thus present a much more complex picture of the early eruption period than has been available up to now. First details of the analysis are to be published in the *Proceedings of the SPIE Technical Symposium East 1981*.—*C. J. Rice and D. K. Watson, contributors*

Earth's Core Iron

Geophysicist J. Michael Brown of Texas A & M University noted recently at the Spring AGU Meeting in Baltimore that the structure and phase of metallic iron at pressures of the earth's inner core (approximately 3.3 Mbar) could have great significance in defining geometrical aspects of the core itself. Brown worked at the Los Alamos Scientific Laboratory with R. G. McQueen to redetermine the phase relations of metallic iron in a series of new shock-wave experiments. They found the melting point of iron at conditions equal to those at the boundary of the earth's outer (liquid) and inner (solid) cores to be 6000° ± 500° C (*Geophysical Research Letters, 7*, 533–536, 1980).

A significant factor in those results is the fact that of the two high-temperature, high-pressure phases of iron, the λ (face-centered cubic, fcc) or ε (hexagonal close-packed, hcp) is stable at the inner-core boundary. Furthermore, at pressures and temperatures of the boundary at the interface between the mantle and the liquid outer core a question arises as to which phase of iron has melted. This factor is important because the closeness in temperature to melting at any point within the liquid outer core could have significant consequences on the geomagnetic dynamo.

Brown and McQueen, while not being able to constrain their data sufficiently to answer the questions unequivocally, nonetheless have come up with the tightest constraints so far in their geophysical model of the core. Their shock-wave data, after reduction from the Hugoniot and even taking into account the uncertainties (see Figure 1, shaded regions), indicate that at pressures equivalent to those in the core, the epsilon-iron (ε-Fe) phase is the best candidate, but it may be too dense. To address the density problem, Brown and McQueen called upon the popular notion that sulfur may be dissolved in the core.

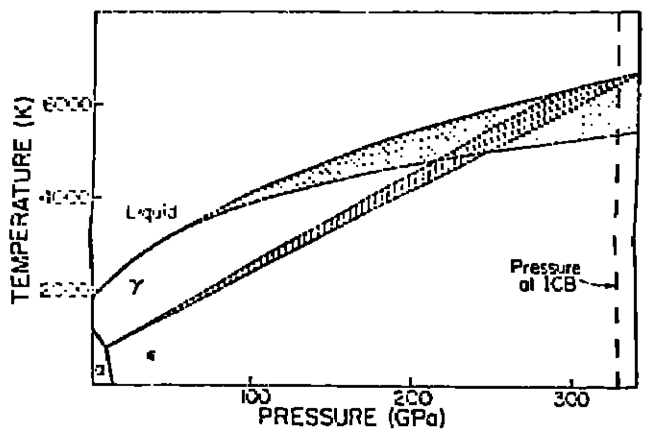

Fig. 1. Phase diagram for metallic iron, based on shock-wave experiments (α = bcc phase; λ = fcc phase; ε = hcp phase; shaded areas represent uncertainties in the data; ICB = inner core boundary). (After J. M. Brown and R. G. McQueen, The equation of state for iron and the earth's core, in *High-Pressure Research in Geophysics*, edited by S. Akimoto and M. Manghnani, in press, APJ, Tokyo, 1981.)

In adding what Brown described as 'component X' (meaning the addition of sulfur to the iron core), complexities such as the ideality of thermodynamic mixing, the bounds of an adiabatic geotherm, and the consequences of liquid thermal convection were considered. If sulfur is dissolved in the iron-rich liquid of the outer core, its concentration must be on the order of 10% by weight, or less, according to the calculations. Problems in the calculations are related not only to the phase of iron but to eutectic melting phenomena that must be evaluated if sulfur is present.

As pointed out by Brown, even with the new data, much remains to be understood about the behavior of materials under the extreme conditions of the earth's core, before the validity of the proposed models can be assessed quantitatively. Most existing theories on melting, convection, and mixing were formulated for simple, pure systems at much lower pressures and temperatures. Even so, these new results constitute the 'state of the art' in our knowledge of the core. Brown proposed the temperature of the core-mantle boundary to be approximately 3700° C for an outer-core liquid composed of iron plus 5%–9% by weight sulfur. This temperature is considerably higher than previous estimates, resulting in necessary reconstruction of the thermal models of the lower mantle. Brown suggests the existence of a 200-km-thick 'thermal boundary layer' in the lower mantle.

Gulf of Mexico Model Confirmed

A model of the origin and evolution of the Gulf of Mexico has been substantially confirmed by core samples taken from the Gulf floor by the *Glomar Challenger*, according to Richard T. Buffler of the University of Texas at Austin and Wolfgang Schlager of the University of Miami, co-chief scientists of the research vessel's leg 77.

Analysis of samples taken from six sites in the southeastern area of the Gulf shows that the Gulf of Mexico originated in much the same way and almost simultaneously with the North Atlantic Ocean. Until recently, the Gulf's origin did not fit the commonly accepted model of ocean evolution, explained Buffler.

The model postulates that the North Atlantic and the Gulf of Mexico began to rift apart about 180 to 200 million years ago when the continents as we know them today formed the supercontinent Pangea. Then, when Pangea broke apart, about 150 to 160 million years ago, the ocean basins of the North Atlantic and the Gulf of Mexico began to form. Rifts also appeared on the seafloor, spewing molten material which then spread out, hardened, and formed new oceanic crust. After that, according to the model, the two basins went their separate ways. The seafloor continued to spread out in the Atlantic, Buffler said, but ceased in the Gulf. The Gulf of Mexico crust continued to subside as it cooled.

Cores recovered by the *Glomar* drilling include material from the old rifted continental crust at two locations, according to Buffler.

The *Glomar's* drilling on this leg turned up other unexpected finds. Cores of rock deposits found at the base of steep carbonate reefs revealed interbedded layers of oxygenated and anoxic limestones that resemble the oil-bearing formations in Mexico. Older carbonate reef material found on uplifted crustal blocks indicates that periods of shallow-water conditions existed in that part of the Gulf before it sank, the University of Texas scientist said.

Deep-water limestones near the reef are a potentially rich source of petroleum. Analyses show that the beds have not been buried deep enough or heated sufficiently to have generated oil, however. Oil stains around asphalt-filled fractures in the rock, though, suggest more mature petroleum source beds could be found at greater depths, Buffler said.

Additional drilling and geophysical studies, including seismic reflection and refraction work, will be needed to substantiate the Gulf of Mexico model further, Buffler told *Eos*.—*BTR*

GAO: Water Monitoring Needs Improvement

Better monitoring techniques are needed to assess the quality of rivers and streams, according to a recent report to Congress by the General Accounting Office (GAO). Water samples are taken too infrequently, GAO says, and stations are placed too far apart 'to deal with the complex nature of water quality.'

'Accurate, reliable data on the actual condition of the nation's rivers and streams are necessary for sound environmental planning and management,' writes Milton J. Socolar, acting comptroller general of the United States, in the cover letter that accompanies the report. 'Existing national water-quality monitoring networks operated by the Environmental Protection Agency [EPA] and the U.S. Geological Survey [USGS] . . . do not provide the type or quality of data needed.'

The existing EPA and USGS water-quality monitors are three fixed-station, fixed-interval sampling networks. These networks routinely and periodically sample the water at fixed locations. But, according to GAO, they lack the ability to record changes in water quality throughout a drainage basin and to record the daily fluctuations of water chemistry, including the amount of dissolved oxygen.

GAO recommends that the network program be replaced by special studies which address specific situations. 'In contrast to the routine approach used in fixed-station monitoring, special studies are tailored to specific hydrologic and water-quality conditions,' the report states. 'Because special studies concentrate on particular problems, they vary widely in sampling frequency, number of locations, and water quality tests. However, they generally involve more intensive sampling of the affected river segments than is done through fixed-station networks.'

Not surprisingly, the USGS and EPA disagree with GAO's recommendations. They maintain that the networks should be continued for national perspective on water quality and other uses.

Last year, in its comments to the draft of the GAO report, EPA said that most weaknesses of fixed-station monitoring that GAO identified 'are also problems with intensive surveys. Therefore,' EPA continued, 'adopting the recommendation to discontinue fixed stations and emphasize intensive surveys will not in itself solve the problems of proper siting, timing, and quality assurance, and may in fact increase these problems.'

The USGS also took issue with the document's draft. The Survey was quick to point out that the two approaches to water-quality investigation are different: 'The objectives of fixed-station monitoring focus primarily on description and characterization of water quality in space and time.' A coordinated series of special studies would not fill these objectives with a national geographic scope, the Survey added.

After reviewing the lengthy comments to its draft report, GAO concludes in its final report to Congress that it stands by its original recommendations.—*BTR*

Space Telescope Shaped and Polished

Shaping and polishing of the 94-inch-diameter (2.4-m) primary mirror for the Space Telescope has been completed at the Danbury, Connecticut, facility of the Perkin-Elmer Corp. The mirror surface has been completed to a perfection that deviates, at any point on the surface, less than one-millionth of an inch from an ideally perfect surface. The primary mirror is the main optical component of the Optical Telescope Assembly (OTA), a major element of the Space Telescope.

The 12-ton unmanned telescope will be placed in circular Earth orbit by the space shuttle in early 1985 and will have an initial altitude of 600 km, putting it well above the interfering haze of Earth's atmosphere. It will enable an investigator to collect data seven times farther into space than now possible—as much as 14 billion light-years—and to observe some 350 times more volume of visible space. The telescope will be able to see stars and galaxies which are as much as 50 times fainter than can now be observed from Earth-based telescopes.

To take full advantage of this undistorted view of space, the telescope optics had to be polished to a much higher accuracy than those used in Earthbound telescopes. Space Telescope's primary mirror was polished to specifications finer than for any previous telescope mirror its size.

The Space Telescope is of an optical design known as Ritchey-Chretien, a folded system with a secondary mirror in front of the primary mirror and the image plane behind the primary mirror.

Manufacture of the primary mirror blank began at Corning Glass Works, Corning, N.Y., in October 1977. The material used for the blank is a Corning product called Ultra Low Expansion glass, which has extremely low thermal expansion properties. The main mirror assembly consists of a front plate about 1 inch thick, with a honeycomb interior separating it from the back plate, also about one inch thick.

The front and back plates and honeycomb interior structure are designed to eliminate any structural change in the mirror caused by either thermal or gravity stresses. While in operation, the front plate of the mirror will exist at near space temperatures, while the back plate operates at near room temperature of 21° C.

The blank was delivered to Perkin-Elmer from the Corning plant in December 1978. Optical fabrication began with rough grinding of the front and back surfaces and of the inside and outside edges of the mirror shape. This was followed by fine polishing of the mirror front surface, using a specially developed computer-controlled polisher and extensive data reduction computer software, which began in August 1980.

In the next stage of fabrication the primary mirror will have two extremely thin, yet uniform, coatings applied to its polished surface. First, a reflective layer of pure aluminum 650 Å thick will be applied and then a protective layer of magnesium fluoride 275 Å thick, which will prevent oxidation of the aluminum.

The coating operation will take place in a specially designed all stainless-steel vacuum chamber. It is the largest chamber of its kind in the world and operates at a vacuum very near that of space.

The requirements for the mirror call for it to be reflective from the extreme ultraviolet (1216 Å—the Lyman alpha line for hydrogen) to the extreme infrared (1000 μ). The mirror specifications call for at least 86% reflectivity at the neon-red resonance line of 6328 Å.

After coating, the mirror will be installed in the Optical Telescope Project and aligned to the secondary mirror, focal plane, scientific instruments, and fine guidance sensors. [Source: NASA]

Forum

Handin Replies to Russell

Your editorial in *Eos*, March 10th, on the functions of the Committee on Education and Human Resources poses several provocative questions but overlooks what I regard as the most critical issue of all. While the Union's efforts to attract more women and minorities into geophysics are commendable, fast becoming more generally serious is the question: how do we recruit *any* students into our graduate schools and then retain them through the doctorate.

The insatiable demand by industry for students at the bachelor's and master's levels in geophysics (and geology and petroleum engineering) has forced starting salaries so high that fewer and fewer students are willing to stay on for graduate work at affordable stipends for fellowships and assistantships. My experience at Texas A&M University may not be typical and may therefore prompt undue exaggeration, but it is certainly not reassuring for the future of higher education.

The combined enrollments of some 600 in our departments of geology and of geophysics are probably among the nation's largest. Of these about 150 are graduate students, but only about 25 are doctoral candidates, and many of them are foreigners who will not be practicing in this country. Worse still, few of our Ph.D.'s become teachers in American universities because dedication alone does not always compensate for the $5000 to $10,000 more that can be earned in industrial research and the national laboratories. Serving as a trade school for industry is one legitimate function of a land-grant institution, but training for careers in higher education is surely another. Nor does the brain drain stop with the students. Recruiting and retaining young faculty have become discouragingly difficult.

So, in my judgment, for many of the fields of earth science the key question is simply this: who will teach the next generation of students our country will desperately need as problems with energy and mineral resources and preservation of a healthy environment become ever harder?

I believe that industry is becoming aware that its sources of adequately trained manpower will vanish—and frighteningly soon—if this wholesale desertion from the academy does not cease. Your committee might wish to address this issue. Industry can help in its own best interests, and discussions with its concerned representatives would be timely.

Aloof like most professors, I have never been an alarmist, but now I honestly believe that the decline of graduate education is too serious to ignore.

John Handin
Associate Dean
College of Geosciences
Texas A&M University

He/Ar Ratio: Earthquake Harbinger

Helium and argon, squeezed out of the earth through fissures by deep internal pressures, may signal an imminent earthquake. There has been little evidence, however, directly linking stress with gas emissions. Ryuichi Sugisaki of the earth sciences department at Nagoya University in Japan reports in the June 12 *Science* that the variations of the He/Ar ratio of gas bubbles in a mineral spring coincide with underground stresses caused by the earth tide.

'A comparison of the variation of strain in the ground resulting from the earth tide with the observed fluctuation of the ratio shows a good correlation,' Sugisaki wrote. In addition, he says that the ratio fluctuation is more closely tied to the tidal strain than to atmospheric pressure or temperature.

Sugisaki bases his report on measurements of the He/Ar ratio of gas bubbles in the mineral water at Byakko Spa in Mizunami, located along the active Byobu-San Fault.

The strain from the earth tide is 100 times less forceful than 'ultimate crustal strain,' which can cause earthquakes, he says. Sugisaki concludes that the He/Ar ratio can be used as a strain gauge for the crust: 'Continuous observation of gas quality at a location geochemically sensitive to stress at depth could therefore be meaningful for earthquake prediction.'—*BTR*

More Fulbright Opportunities

Six Fulbright awards are available for research, in any field, to be performed in Africa for 3 to 9 months between September 1982 and September 1983. Also available are 21 awards for research in India, in any field, for which the grant duration is 2 to 10 months during the 1982–83 academic year. Application deadline for all awards is August 1, 1981.

An announcement booklet, 'Fulbright Lecturing and Research Abroad, 1982–83,' includes terms of award, requirements, and selection criteria. To receive the brochure, write to the Council for International Exchange of Scholars, 11 Dupont Circle, N.W., Dept. N, Washington, D.C. 20036.

Geophysical Events

This is a summary of *SEAN Bulletin, 6*(5), May 31, 1981, a publication of the Smithsonian Institution. The complete bulletin is available in the microfiche edition of *Eos*, as a microfiche supplement, or a paper reprint. For the microfiche, order document number E81-003 at $1.00 from AGU, 2000 Florida Avenue, N.W., Washington, D.C. 20009. For reprints order *Sean Bulletin* (give dates and volume number) through AGU Separates: $3.50 for the first copy for those who do not have a deposit account; $2 for those who do; additional copies are $1.00. Orders must be prepaid.

Volcanic Events (All times are local)

✓Pagan (Mariana Is.): Strong activity ends; USGS observations summarized.
Alaid (Kurile Is.): April–May eruption detailed.
Mt. St. Helens (Washington): Lava extrusion adds to preexisting dome.
Kilauea (Hawaii): First intrusion into the southwest rift in more than 6 years.
• Semeru (Indonesia): Mudflow kills more than 250.
Piton de la Fournaise (Réunion Is.): Earthquake swarm; 1981 flows mapped.
Krafla (Iceland): Slow inflation continues; SO_2 measured.
Arenal (Costa Rica): Lava extrusion continues.
Poás (Costa Rica): Incandescence observed.
Langila (New Britain): Weak ash emission.
Manam (Bismarck Sea): Ash ejection and glow.
Asama (Japan): Increased seismicity but no eruption.
Sakurazima (Japan): Explosions; ash ejection; B-type earthquakes.
Atmospheric Effects: Volcanic material in stratosphere over Virginia, Wyoming, and Colorado; source uncertain.

Pagan Volcano, Mariana Islands, Western Pacific Ocean (18.13°N, 145.80°E). A major eruption of North Pagan started May 15 (see May 26 *Eos*), preceded by earthquakes first felt in late March or early April. On May 15, the first of a series of closely spaced earthquakes (at least 13 felt) began at 0745 (1745 GMT). At 0915, residents heard a loud boom, followed immediately by the beginning of the eruption, which apparently reached full intensity almost immediately. Three vents, oriented about N-S, were active. Airline and rescue pilots reported that the height of the eruption cloud exceeded 13 km, and Japan-based weather radar reported ash to heights of 18–20 km. Lava flows were noted by residents very soon after the appearance of the ash-scoria column, and geologic observations show that ash eruption and lava emission took place simultaneously during most of the eruption. At 1930 there was a notable decrease in plume height and density. The U.S. Navy reported a brief period of vigorous ash ejection around noon the next day, and incandescent activity was seen May 19 from Alamangan Island, 35 km away.

A USGS team of Norman Banks, Robert Koyanagi, and Kenneth Honma observed only intermittent eruptive activity during their May 20–28 stay on the island. Increases in the level of harmonic tremor and the number of discrete higher-frequency events preceded three episodes of extrusion of small aa lava flows and one period of ash emission. After May 26, only minor fuming was observed.

The volume of eruptive products ejected through May 28 exceeded $50 \cdot 10^6$ m³, and a large part of the arable land was covered by lava flows and airfall ash and scoria. Lava flows were predominantly aa, ranged from 3 to 30 m in thickness and traveled as much as 3.5 km from the vents. The northernmost vent (about 1 km north of the summit) built a tephra cone about 80 m high that covered an area of 0.90 km². Ash and scoria deposits exceeded 2 m in thickness northwest of the summit crater. Lithic blocks and juvenile bombs as large as 1 m in diameter were thrown more than 2 km from the summit onto the north flank of the volcano. Base surges, evidenced by low-amplitude (4–20 cm) dune and antidune features and preferential upslope tree damage, flowed down restricted corridors to elevations of 200 m on the north and south slopes. Devastating phenomena, such as widespread pyroclastic flows, did not take place. The events of May 15 caused no injuries to the residents, but some livestock were killed outright and others were starving because of the extensive destruction of vegetation.

The level of a west flank lake dropped regularly at a rate of about 24 mm/day during the 8-day USGS visit. The highest of four stations of an electronic distance-measuring array installed on the south flank moved steadily southward, 66 mm in 6 days. Little movement was noted from the stations lower on the flank. Seismic monitoring May 20–28 showed continuous harmonic tremor and short bursts of high-frequency signals, indicating intermittent extrusive events such as degassing and low-level lava fountaining. However, no significant earthquake activity was detected.

Electron microprobe analysis of one fused sample of airfall scoria (by John Sinton, University of Hawaii) indicated that it was more or less typical of basalts from the northern Marianas.

Information contacts: Norman Banks, Robert Koyanagi, and Kenneth Honma, Hawaiian Volcano Observatory, USGS, Hawaii Volcanoes National Park, Hawaii 96718 USA.

Semeru Volcano, Java, Indonesia (8.11°S, 112.92°E). Thirty centimeters of rain in 2 hours on May 14 dislodged pyroclastic deposits from the upper flanks of Semeru. Approximately 5–6 million m³ of breccia, volcanic sands, ash, surficial cover, and vegetation slid down the 40°–60° eastern flank into the valleys of the Tunggeng and Sat rivers. The mudflow killed 252 persons, left 152 injured and 120 missing, and flooded 626 hectares of rice fields and 16 villages along the rivers' banks. It eroded old lahar deposits and washed away a dike built in 1912 after a similar event had destroyed the city of Lumajang (40 km east of the volcano) in 1909.

In January, the Volcanological Survey of Indonesia had warned local authorities in regions south and southeast of Semeru of the danger of mudflows because of the onset of the monsoon and the presence of fresh nuée ardente deposits on the upper south flank (see April 7 *Eos*). Although a lahar also moved down the south flank on May 14, no casualties were reported there.

Activity at Semeru was normal during May, with about 80 gas eruptions each day. The lava dome continued to grow at about 100 m³ a day.

Information contact: A. Sudradjat, Director, and L. Pardyanto, Senior Volcanologist, Volcanological Survey of Indonesia, Diponogoro 57, Bandung, Indonesia.

Earthquakes

Date	Time GMT	Magnitudes	Latitudes	Longitudes	Depth of Focus	Region
May 2	1605	6.3m_b	36.42 N	71.16 E	225 km	NE Afghanistan
May 25	0525	7.5M_s	48.82 S	164.90 E	10 km	Tasman Sea, SW of New Zealand

The May 2 earthquake was widely felt. It was centered in the Afghanistan-Pakistan-USSR border region, about 275 km NNE of Kabul. The May 25 shock occurred in the ocean on the western slope of the New Zealand Plateau, about 350 km SW of South Island, New Zealand. No casualties or damage were reported for either event.

Information contacts: National Earthquake Information Service, USGS, Stop 967, Denver Federal Center, Box 25046, Denver, Colorado 80225. Geological Survey of Pakistan, Quetta, Pakistan.

Meteoritic Events

Fireballs: Atlantic Ocean, Austria, Brazil, Czechoslovakia (2), England, Mediterranean Sea, Syria.

• Entire report printed
✓ Excerpts of report printed

New Publications

Numerical Methods in Geomechanics, vol. 4

W. Wittke (Ed.), Balkema, Rotterdam, The Netherlands, vi + 296 pp., 1980.

Reviewed by E. G. Bombolakis

This volume is the fourth of four volumes that developed from the Third International Conference on Numerical Methods in Geomechanics, held in Aachen, Germany. The publisher of these volumes advertises itself as a small internationally oriented firm that offers special services for publication of conference proceedings. Three of these services are especially worth noting to facilitate understanding of the pros and cons of the volume under consideration. The three services are (1) production from camera-ready copy within 8 weeks, (2) no charge for the production, and (3) specimen pages, typing instructions, and paper supplied to each author. Each author accordingly prepares or supervises preparation of his own 'galley proofs.'

The resulting speed of publication is impressive. Despite the fact that the conference was held in April 1979, four volumes of 130 papers in hardcover clothbound form were available to the public in 1980. The speed of publication is admirable and desirable in view of the long delay frequently involved in the publication of many conference proceedings, provided of course that there is proper peer review and adequate editorial control. This proviso appears to be a fundamental problem here.

This book review is concerned only with volume 4. There is no evidence in this volume that the papers were subjected to proper external peer review. In fact, there are four lines of circumstantial evidence that there was little or no peer review and inadequate editorial control of the 22 papers in this volume. First, there is one paper in which there are no figures. It reads like a paper presented at a meeting by a speaker who forgot to bring projection slides that would illustrate the talk. Second, there was only one discussion of one paper. The discussion was critical of that paper in more than one important respect, but no reply to the discussion was published. Third, the English language in a number of papers by foreign authors is written in quaint and confusing styles. Fourth, there is no indication of external peer review in any of the acknowledgements that are recorded in the papers. For example, a few authors acknowledged helpful comments, but only from colleagues at their own institutions.

On the basis of a reading of each paper, it is appropriate here to paraphrase one of James Gilluly's judgements in a book review he wrote for *EOS* (published in *6*, 22, May 29, 1979). Namely, as is the case with most symposia, the product is a mixed bag: some good papers, a considerable number of repetitive papers, and a notable bunch of expensive waste paper. The papers in volume 4 deal with seven main topics: theoretical developments, flow and consolidation, constitutive laws, rock behavior, embankments and slopes, dynamics, and soil-structure-interaction with respect to foundations. Several important concepts of soil mechanics (e.g., the concept of residual strength) occasionally are applied to rock mechanics problems, even though present-day documentation is not sufficient to justify the validity of this procedure. Many of the papers employ finite element techniques in analyses of nonlinear soil and rock mechanics problems. The interested reader who is not familiar with finite element analysis can find a good concise explanation with worked-out examples in Richard Goodman's book, *Methods of Geological Engineering*, published by West Publishing in 1976. One of the most crucial factors in the entire analysis is the way in which constitutive laws are formulated and used in the analysis. It is this factor that provides one clue for recognition of some of the better papers.

The lack of proper external peer review and editorial control makes the publication of conference proceedings unfair to the reader, to the authors of the better papers, and to the profession involved. This situation also makes it difficult for a reviewer to be fair in crediting what seems to be all of the better papers. Only a few can be mentioned here, particularly those of potential interest to AGU members. For example, the paper 'Nonlinear effects in dynamic soil structure interaction,' by J. M. Roesset and H. Scaletti, makes an evaluation of such effects for nuclear power plant type structures, with particular emphasis on the relative importance of partial separation and sliding of the foundation. The paper, 'Development of an analysis for cyclic axial loading of piles,' by H. G. Poulos, is of particular interest for two reasons. First, it is relevant to pile foundation problems for offshore platforms. Second, even though the analysis is based on elastic theory, it makes allowance for pile-soil slip and soil nonhomogeneity in terms of some rather basic principles. Finally, the paper 'Stress-strain theory for normally consolidated clay,' by P. V. Lade, will be an important contribution if his assertion proves to be correct. The assertion is that he has shown how 10 material parameters can be used to calculate strains in the Grundite Clay for any combination of effective stresses during primary loading, unloading, and reloading. Incidentally, no abstracts are incorporated in any of the papers in this volume.

E. G. Bombolakis is with the Department of Geology and Geophysics, Boston College, Chestnut Hill, Massachusetts.

New Listings

Items listed in New Publications can be ordered directly from the publisher; they are not available through AGU.

Acid Precipitation—Effects on Forest and Fish, Final Report of the SNSF Project 1972–1980, L. N. Overrein, H. M. Seip, and A. Tollan (Eds.), Recleme, Oslo, Norway, 175 pp., 1980, Available free of charge.

Advances in Food-Producing Systems for Arid and Semiarid Lands, Parts A + B, J. T. Manassah and E. J. Briskey (Eds.), Academic, New York, xvi + 1274 pp., 1981, $110.00.

Advances in Space Research: Planetary Interiors, H. Stiller

and R. Z. Sagdeev (Eds.), Pergamon, New York, x + 265 pp., 1981.

A Guide to Classification in Geology, J. W. Murray, John Wiley, New York, 112 pp., 1981, $19.95.

Applied Geophysics for Geologists and Engineers: The Elements of Geophysical Prospecting, 2nd Ed., D. H. Griffiths and R. F. King, Pergamon, New York, xii + 230 pp., 1981, $14.50.

Astronomy and Astrophysics Abstracts, vol. 28, S. Böhme, W. Fricke, I. Heinrich, W. Hofmann, D. Krahn, D. Rosa, L. D. Schmadel, and G. Zech (Eds.), Springer-Verlag, New York, x + 841 pp., 1981, $56.20 cloth.

Case-Studies in Groundwater Resources Evaluation, J. W. Lloyd (Ed.), Clarendon, Oxford, 206 pp., 1981, $74.00.

Cosmic Plasma, H. Alfvén, D. Reidel, Hingham, Mass., xi + 164 pp., 1981, $39.50.

Developments in Geophysical Exploration Methods—2, A. A. Fitch (Ed.), Applied Science Publishers Ltd., London, ix + 234 pp., 1981, $36.00.

Economic Geology and Geotectonics, D. H. Tarling, John Wiley, New York, x + 213 pp., 1981, $54.95.

Energy at the Surface of the Earth: An Introduction to the Energetics of Ecosystems, D. H. Miller, Academic, New York, xvii + 516 pp., 1981, $49.50.

Evolutionary Biology of the New World Monkeys and Continental Drift, R. L. Ciochon and A. B. Chiarelli (Eds.), Plenum, New York, xvi + 528 pp., 1980, $49.50.

Exploration of the Polar Upper Atmosphere, J. A. Holtet and C. S. Deehr (Eds.), D. Reidel, Hingham, Mass., xvi + 498 pp., 1980, $58.00.

Geographic Names of the Antarctic, F. G. Alberts (Ed.), National Science Foundation, Washington, D.C., xxii + 959 pp., 1980, Available from Superintendent of Documents, GPO, Washington, D.C.

Geology of the Continental Margins, G. Boillot (translated by A. Scarth), Longman, Inc., New York, xi + 115 pp., 1981, £4.95.

Geothermal Systems: Principles and Case Histories, L. Rybach and L. J. Muffler (Eds.), John Wiley, New York, xiv + 359 pp., 1981, $61.95.

Geothermie: Eine Einführung in die Allgemeine und Angewandte Wärmelehre des Erdkörpers, G. Buntebarth, Springer-Verlag, New York, ix + 156 pp., 1980, $14.20.

Highlights of the Japanese IMS Program, Institute of Space and Aeronautical Science, Tokyo, Japan, xii + 445 pp., 1980.

Mathematical Modeling of Hydrologic Series (translated from the Russian by T. Guerchon, edited by D. Percious; original previously reviewed in *Eos, 59*(5), 465–466, 1978), G. G. Svanidze, Water Resources Publications, Ft. Collins, Colo., x + 314 pp., 1980, $25.00 (subject to change without notice).

Monsoon Dynamics, J. Lighthill and R. P. Pearce (Eds.), Cambridge University Press, New York, xxii + 735 pp., 1981, $130.00.

Potable Water From Wastewater, M. T. Gillies (Ed.), Noyes Data Corporation, Park Ridge, New Jersey, xii + 305 pp., 1981, $42.00 (cloth).

Proceedings of the International Committee on Geodynamics, Group 6 Meeting at Peshawar, November 23–29, 1979, R. A. K. Tahirkheli, M. Q. Jan, M. Majid (Eds.), National Centre of Excellence in Geology, Peshawar, Pakistan, 213 pp., 1980, 65 French francs (hardback), 55 French francs (paperback). Available from P. Le Fort, C.R.P.G., B.P. 20, 54501 Vandoeuvre-lès-Nancy Cedex, France.

Reference Coordinate Systems for Earth Dynamics, E. M. Gaposchkin and B. Kolaczek (Eds.), D. Reidel, Hingham, Mass., xiv + 396 pp., 1981, $49.95.

Reflection Seismology: A Tool for Energy Resource Exploration, 2nd ed., K. H. Waters, John Wiley, New York, xvi + 453 pp., 1981, $44.95.

Classified

EOS offers classified space for Positions Available, Positions Wanted, and Services, Supplies, Courses, and Announcements. There are no discounts or commissions on classified ads. Any type that is not publisher's choice is charged for at display rates. EOS is published weekly on Tuesday. Ads must be received in writing on Monday 1 week prior to the date of the issue required.

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Visiting Scientist Position/The Joint Institute for the Study of the Atmosphere and Ocean, University of Washington. Visiting scientists with background in atmospheric sciences or physical oceanography and interests in dynamical and/or geochemical aspects of climate variability. Term of appointment: one (1) year, renewable for a second year subject to the approval of the Council. Closing date: September 15, 1981. Send curriculum vitae and a brief research prospectus to Director, JISAO, c/o Department of Atmospheric Sciences, AK-40, University of Washington, Seattle, WA 98195.

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Geohydrology/Geochemistry/Economic Geology. Applications are invited for a one year appointment effective August 19, 1981 to teach undergraduate courses in introductory geology and either geohydrology, geochemistry, or economic geology. Ph.D. preferred but will consider ABD. The position will be reannounced in September 1981 as a tenure track slot at the assistant professor level with teaching and research duties about 50-50. Applications including resume and names of three references should be sent to W. D. Gosnold, Jr., Department of Geography-Geology, University of Nebraska at Omaha, Omaha NE 68182.

An AA/EO employer.

Division of Petroleum Engineering and Applied Geophysics, Norwegian Institute of Technology, N-7034 Trondheim-NTH, Norway. The above mentioned division has available two research positions on its research project: 'Basement tectonics of the Norwegian continental shelf'. The positions are in any of the categories:

Senior Geologist/Geophysicist (Salary Norw. cr. 119,000—per year), Geologist/Geophysicist (Salary Norw. cr. 108,000—per year), and Junior Geologist/Geophysicist (Salary Norw. cr. 98,000—per year)

The project will run over a four-year period. Appointments are made on a yearly basis with possibility of extension. Salaries stated are in Norwegian crowns per year and before tax. Non-Scandinavian citizens require a work permit. Those appointed will collect, compile and interpret reflection seismic, refraction seismic, well, gravimetric, aeromagnetic, marine magnetic, geological and lineament tectonic data from a large land and offshore area. All positions require sound qualifications in applied geophysics and geology at university level. Further requirements are ability to work independently within an integrated research group and a working knowledge of English which is the working language of the project. The senior position includes responsibilities for the day-to-day activities of the research group and requires several years' previous experience in relevant research. There are excellent opportunities for further studies in geology and geophysics and for learning Norwegian. All results of the project can be published. Qualified candidates may apply for the status of research student and use results of their research for their thesis in partial fulfilment of the requirements for a doctor's degree, subject to approval from the Norwegian Institute of Technology, University of Trondheim. Further information can be obtained directly from scientific assistant J. Holthe (Tel. 075-94934) or Professor J. Hospers (Tel. 075-94949) at the above mentioned Division, or by letter. Applications including detailed information on the applicants' qualifications are to be sent to Prof. Dr. J. Hospers at the above mentioned division as soon as possible. State which position the application refers to and when available.

Sedimentologist or Sedimentary Petrologist/University of California, Santa Barbara. (Correction) Applications are invited for a tenure track appointment in soft rock geology to be filled in 1981–82. Rank dependent on qualifications and experience but preference will be given to the assistant professor level. Applicant should normally have a Ph.D. and strong field-orientation and quantitative background. The candidate will be expected to develop a strong research program in sedimentation. The candidate will also be expected to teach at both undergraduate and graduate levels and interact with students and faculty of the department, particularly in the general areas of diagenesis, volcanic processes, paleomagnetics, as well as field geology. Additional duties may include teaching physical geology and summer field geology.

Please send resume, other documentation of abilities, and four letters of recommendation by September 30, 1981 to Dr. Arthur G. Sylvester, Chairman, Department of Geological Sciences, University of California, Santa Barbara, CA 93106. Telephone (805) 961-3156.

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Scientist. Immediate opening for Scientist with experience in Lidar Analysis Techniques and Optics. Familiarity with Laser and Optics Instrumentation a plus. Candidate must possess a PhD in Atmospheric Science Optics/Physics.

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Physical Oceanographer. The New Orleans OCS Office, Bureau of Land Management, is seeking qualified candidates for a staff oceanographer to supervise contracted marine environmental research. The primary areas of research will be physical oceanography and meterology. Duties include: serving as a contracting officer's authorized representative, developing study plans and work statements, and advising management on matters within the candidate's area of expertise. Candidate should have a M.S., Ph.D. preferred. Grade level: GS-11 or GS-12, salary $22,486–$26,951. Responding to announcement no. WO-81-140, send a current SF-171 to arrive no later than July 21, 1981 to Personnel Services (834) U.S. Department of Interior Bureau of Land Management, 18th & C Streets, NW, Washington, D.C. 20240 or call in verbal application at 202-343-7845.

Postdoctoral Position in Geochemistry/Cosmochemistry, University of Arizona. Applications are invited for a postdoctoral research associateship in the Lunar and Planetary Laboratory at the University of Arizona. The associate will collaborate with Dr. William V. Boynton in ongoing investigations of the refractory inclusions in carbonaceous chondrites. The selected applicant will have major responsibilities to conduct mineralogical investigations to supplement existing neutron activation analysis studies. Experience with an electron microprobe is essential; experience with neutron activation is desirable. Facilities include a fully automated SEM/microprobe, numerous gamma-ray detectors including a Compton-suppression spectrometer, several computers and a TRIGA reactor.

Applications, accompanied by a resume, statement of research interests, and complete bibliography, should be sent to Dr. William V. Boynton, Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721. Letters of recommendation, directed as above, should be requested from at least three persons who are well acquainted with the applicant's accomplishments and potential. To receive full consideration, application materials should be received by August 31, 1981.

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Atmospheric Scientist/Group Head. Senior staff scientist position available immediately at the NAIC's Arecibo Observatory. The successful applicant will be appointed as Head of the Atmospheric Sciences Group and will be expected to lead that group and to perform independent research using the Arecibo facilities. A Ph.D. degree in atmospheric or physical sciences or radar engineering and a record of solid research accomplishments are required. Experience with radar studies of the stratosphere, mesosphere, and ionosphere or with HF modifications of the ionosphere is desirable. Salary open. Please send resume and names of at least three references to Dr. Harold D. Craft, Jr., Director, Arecibo Observatory, Space Sciences Building, Cornell University, Ithaca, New York 14853.

NAIC/Cornell University are EOE/AAE.

Meteorologist/Remote Sensing. Immediate opening for candidate with a PhD in Meteorology with post graduate research experience and interest in Remote Sensing.

Send resumes to Melba Houston, Technical Recruiter, Systems and Applied Sciences Corporation, 6811 Kenilworth Avenue, Riverdale, Maryland 20840.

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The Director is responsible for overall research planning and management, including fiscal monitoring and budgeting; coordination of operations for modern computer facilities and two deep-ocean research vessels; and interfacing with industrial and agency sponsors and the University administration and faculty. Applicants will also be considered for a concurrent faculty appointment in the Department of Geological Sciences. The position is located in Austin.

Applicants should hold a Ph.D. in geology or geophysics, or another relevant field, and have demonstrated creativity in research and development through publications and other forms of appropriate documentation. Previous administrative experience is desirable. The salary is open. Applications should be received no later than October 1, 1981. The position will be effective as soon as possible. Please forward applications, curriculum vitae, references, and any other supporting materials to:

Dr. G. J. Fonken
Vice-President for Academic Affairs and Research
The University of Texas at Austin
Main Building #201
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Head, Department of Oceanography & Ocean Engineering. The Florida Institute of Technology seeks an individual to head a multidisciplinary department of scientists and engineers. Position to commence as early as September 1981. Candidates must possess a Ph.D. degree and have demonstrated meritorious scientific work in oceanography or ocean engineering with interest and experience in teaching, research, and administration. The Department has graduate and undergraduate interdisciplinary programs in biological, chemical, geological and physical oceanography, and ocean engineering. Curricula for the Ph.D. are available in physical, chemical, and biological oceanography. The department is part of a fast rising university in a community on the east coast thriving with technical industries. Benefits include free tuition for family members. Send resume and names of references to: Chairman of Search Committee, Department of Oceanography & Ocean Engineering, Florida Institute of Technology, Melbourne, FL 32901.

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Polar Oceanographer/Sea Ice Dynamicist. A position is available under the Intergovernmental Personnel Act of 1970 for persons now employed in State/local government or in colleges and universities. This position is located within the Oceanic Processes Branch of the Environmental Observation Division of the Office of Space and Terrestrial Applications, NASA Headquarters. The position is for one year, with the possibility for renewal for an additional year. Pay will be at a level commensurate with experience, and will be established after a review of qualifications.

Candidates must have been employed by the university in a permanent position for at least 90 days or be a career employee of a State or local government. Candidates must also meet the Federal qualification standards for the position. These are as follows: a degree in an appropriate field of science, plus three years of progressively responsible experience in duties related to the position.

This individual will be responsible for planning, developing, and implementing a scientific research program in satellite remote sensing of oceanic processes in polar regions. A background in polar oceanography, sea ice dynamics, or a closely-related field is required; experience in remote sensing, although desirable, is not essential. A Ph.D. or equivalent training and experience is mandatory.

Interested parties should send a current resume to NASA Headquarters, Attn: Mrs. Catherine Zegowitz, Code EPM-3, Washington, D.C. 20546.

Selection for this position will be made from otherwise eligible candidates without discrimination for any nonmerit reason such as race, color, religion, sex, national origin, politics, marital status, physical handicap, age, membership or nonmembership in an employee organization, or personal favoritism.

Electron Microprobe Technical Specialist/University of Colorado. The department of Geological Sciences, University of Colorado, Boulder, seeks a person who will assume responsibility for the department's electron microprobe laboratory. Duties will include day-to-day operation of our MAC 400 microprobe equipped with a KEVEX EDS system, instruction of new operators, maintenance of the microprobe as well as other X-ray equipment within the Department, microprobe software and hardware development, and participation in research projects involving silicate, sulfide and oxide mineralogy. The job requires either a degree in electronic or electrical engineering, or two years of technical experience utilizing electronic instrumentation associated with an electron column instrument. An individual with an M.S. degree in Geology and microprobe experience will be considered highly desirable. Salary ranges from $20,000–$25,000 depending on experience. Please send, by August 15, letter of application and resume to Bruce Bedger, Personnel Department, University of Colorado, 1511 University Avenue, Boulder, CO 80309.

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Physical Oceanographer. A postdoctoral research position in physical oceanography is available at the University of North Carolina at Chapel Hill, to begin as early as August 1981. Ph.D.'s with background and interests in mesoscale Gulf Stream dynamics, geophysical fluid dynamics, or ocean acoustics are encouraged to apply. Initial appointment will be for one year with a possible continuation through a maximum of three-years. Please send vitae and the names of three references to Professor John M. Bane, Marine Sciences Program, 12-5 Venable Hall 045A, University of North Carolina, Chapel Hill, North Carolina 27514.

The University of North Carolina is an affirmative action/equal opportunity employer.

Land Stability Scientist, Aokautere Palmerston North, New Zealand. Scientist or engineer to lead a group of five scientists and two technicians at the Water and Soil Division, Ministry of Works and Development, Aokautere Science Centre at Palmerston North, New Zealand in studies of land instability. Technical support available from four other groups on campus—plant materials for erosion control, land resource surveys, catchment condition surveys (remote sensing), and hydrology. The study of the role of plants in stabilising grazed hill country is a central concern. It is hoped that the land stability group will improve understandings of basic mechanisms of slope instability—particularly soil/plant/water inter-relationships.

Qualifications sought are Ph.D. or good honours degree in soil physics or soil mechanics, backed by experience in land instability research or areas related to it.

Applications giving details of qualifications and experience to be sent to
The First Secretary (Administration)
New Zealand Embassy
37 Observatory Circle, N.W.
Washington, D.C. 20008
for forwarding to Ministry of Works and Development, P.O. Box 12-041, Wellington North, New Zealand.

Research Position/Space Plasma Physics. Applications are invited for two possible research positions in the Department of Space Physics and Astronomy, Rice University.

One position involves work on a computer code for simulating the large-scale dynamics of the earth's ionosphere and magnetosphere, including computer simulation of specific events and comparison with ground and satellite data. Preference will be given to applicants having experience with space or laboratory plasma physics, and with large computations.

The second possible position involves analysis of data from Atmosphere Explorer and Dynamics Explorer spacecraft. Preference will be given to applicants having experience with space plasmas and with reduction of spacecraft data.

Title and salary for either position will be arranged, depending on experience. Please send resume and bibliography to R. A. Wolf or P. H. Reiff, Department of Space Physics and Astronomy, Rice University, Houston, TX 77001.

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AGU

AGU Awards

Tenth Presentation of the

Walter H. Bucher Medal
to
Jack Oliver

for original contributions to the basic knowledge of the earth's crust

Citation

Walter Bucher was a true student of the earth. He began as a zoologist, turned to paleontology in graduate school, and became interested in structural geology through studies of deformed fossils in the Alps. His book, *Deformation of the Earth's Crust*, first published in the 1930's, was a heroic attempt to find order in the structure of the globe. He has a long association with the American Geophysical Union and was its president from 1950–1953.

Jack Oliver was a student of Walter Bucher at Columbia, and perhaps some of Walter's versatility rubbed off on him. Jack began his geophysical career in the atmosphere, tried the oceans but found them too unstable, and tested the Arctic ice before settling on the solid earth. Although he is claimed by the seismologists as one of their own, he has always maintained a strong interest in the crustal rocks and their structure in addition to his interest in their elastic properties.

Jack was also a student of Maurice Ewing and invented two-dimensional model seismology [in response] to a question on one of Ewing's geophysics examinations that those in the class answered unimaginatively. The paper describing the techniques was selected as a classical paper by the Society of Exploration Geophysicists. His Ph.D. thesis was on the use of surface waves to determine the structure of the Pacific region, and about the same time he used Lg wave propagation to study the crustal structure of the Arctic. With Press and Ewing he applied normal mode theory to the determination of crustal structure in many parts of the world. He pioneered in the study of higher modes of surface waves and their application to study of the crustal rocks and their sedimentary cover.

Jack recognized in the early 1960's the importance of studying deep-focus earthquakes and the phenomena associated with them. So he established a seismograph network where they are most frequent—in the Tonga-Fiji region. Data from this network led to definition of the subduction process, a vital link in the chain of ideas that make up our currently accepted model of plate tectonics. He and his students have continued to contribute new data and ideas that further strengthen the model.

More recently Jack turned his attention to the continents. The successes of the last quarter century in defining the ocean crust and mantle were not matched by equal [advancement] in understanding of the deep continental crust. Jack was a prime mover in establishing the Consortium for Continental Reflection Profiling (COCORP), whose objective is to examine the fine structure of the crust and upper mantle, using advanced reflection techniques. The results to date have provided answers to some long-standing problems of crustal deformation and have given us new insights into the third dimension of the continental crust.

The Bucher medal is in recognition of outstanding contributions to the basic knowledge of the deformation of the earth's crust. Jack has devoted a major part of his career [to] making such contributions, using the propagation and attenuation of seismic waves; seismicity and first motion studies; new geophysical techniques; even surface geology. He has nurtured numerous students, many of whom are also leaders in the field, and [he] has contributed generously of his time to professional societies and committees.

President Wilson, the nominating committee for the Walter H. Bucher Medal presents its nominee, Dr. Jack E. Oliver. I have the feeling that this may please you since he helped to write the citation for the first presentation of this medal in 1968 to you.

Charles L. Drake

Acceptance

I feel very honored, very pleased, and very fortunate to receive the Walter Bucher Medal. Good fortune has long been a part of my career: first, in the choice of this fascinating occupation of earth science, and then in countless stimulating and productive interactions with colleagues, associates, and, particularly, students. I could not stand here and accept this medal without crediting and thanking all of them. Good fortune also brought me my fine wife, Gay, who shares this honor with me, and two delightful teenage daughters, who, among other things, keep my ego in check on occasions like this.

After Maurice Ewing, Walter Bucher was the professor who most affected my attitude toward earth science, and so I am especially pleased to receive his medal, and I would like to tell you a few stories about him. Probably everyone who ever knew Bucher was infected by his enthusiasm for study of the earth. He was a geologist with little training in physics, but he was totally committed to the application of the methods and principles of physics to the study of the earth.

In the late 1940's, because of this special conviction, he opened his graduate course in structural geology to physics students with no previous training in earth science, and that course was my introduction to geology. It was tough going for me but probably more so for Bucher. When he used a term like 'Triassic red beds,' there was at least one student who didn't know what Triassic meant, who thought of beds solely as parts of bedrooms or flower gardens, and who had never seen any rocks that could truly be described as 'red.' In fact I still haven't!

Once I asked a fellow student whether it was the synclines or the anticlines that bowed down. He said, 'The word is anticline!,' and walked away in disgust. So you can see what Bucher was willing to endure in order to integrate physics and geology.

Bucher's classes were a source of great encouragement for young students. With a curious mixture of pride and humility he related how many of the conclusions of his book on the deformation of the earth's crust had been proven incorrect by later observations. In the process he somehow left us completely convinced that it was not only our opportunity but our destiny to make new kinds of observations and so to discover the ultimate geologic truths.

Later on I took Bucher's seminar in tectonics. At that time he was enthralled by the potential of marine geophysical studies of the ocean basins, and he dreamed of similar surveys of the continents. Sometimes more enthusiastic than practical, he once proposed that a balloonist might drift over the Alps, reading a gravimeter and magnetometer and throwing out explosive charges to be recorded by a balloonborne seismograph! The class, perhaps fearful of starting World War III, discouraged him on this point. However, although I can't be certain, that discussion may have been the start of the COCORP project.

Once in the 1950's Lester King, the well-known South African proponent of continental drift, visited Columbia to give a seminar on that subject. His presentation was set up as a debate between King and Bucher, who represented the fixists. Much to his credit, Bucher, intentionally I am sure, gave a very weak defense of the fixist position. King thus 'won' the debate handily. As a result, the graduate student body was stimulated for months over the possibility of continental drift. It was many years before most of us returned to that position, but had he lived, none would have been more delighted than Bucher by the coming of plate tectonics.

After Bucher retired from Columbia he took a position with Humble and was seen only infrequently by former colleagues. One evening during that period, as I was walking home from Lamont along a back road, a car passed me at fairly high speed. When the driver, who was Bucher, recognized me, the car skidded to a halt in a cloud of dust and backed up quickly to where I was. I hadn't seen him in years, so when he said 'Hello, Jack. How are you?,' I thought it nice that he wanted to renew our friendship. However, before I could answer that simple and cordial question, he fired off a technical one: 'Have there been any deep earthquakes beneath Italy lately?' Well there had been, so I began a sentence with that information. After half a dozen words that conveyed the meaning, he interrupted with a hearty 'Thank you!' Immediately the car sped off, leaving me standing in another cloud of dust, with my eyes following that unusual man who was always on fire with enthusiasm for the study of the earth and who ignited that same fire in everyone he encountered. I think that was the last time I saw Walter Bucher, and that is the way I like to remember him.

Jack Oliver

Meetings

Call for Papers: Chapman Conference

A Chapman Conference on Rainfall Rates will be held in Urbana, Illinois, April 27–29, 1982. Convened by D. M. Hershfield, the conference seeks to bring together an interdisciplinary group for an interchange of ideas on current research and to outline future research and instrumentation needs. The information to be presented at the conference will be of value to scientists and engineers in the fields of communications, space technology, atmospheric remote sensing, cloud physics, airplane safety, and others interested in very intense, short duration rainfall. The conference is cosponsored by the American Geophysical Union Precipitation Committee, the American Meteorological Society Committee on Meteorological Aspects of Aerospace Systems, the American Meteorological Society Radar Committee, and the National Aeronautics and Space Administration.

Sessions Planned

Atmospheric physics as related to rainfall processes.

Measurement: mass (tipping bucket), photoelectric, magnetic, and remote methods.

Models: physical, mathematical, and statistical.

Applications: point, area, quasihorizontal path, surface, troposphere, and stratosphere.

Format and Abstracts

The conference will last 3 days and will consist of both invited and contributed papers. To ensure adequate time for discussion, poster sessions may be used. Persons interested in attending should send their name, address, phone number, and reasons for wanting to attend to AGU. To submit an abstract, follow the format published for the AGU fall meeting (see page 586 of *Eos*, June 30, 1981). For submittal information, you need only to indicate the name of the meeting and the type of presentation. There will be no abstract charge. Send abstracts to Meetings, AGU, 2000 Florida Avenue, N.W., Washington, D.C. 20009. **Deadline for abstracts is December 21, 1981.**

Student Travel

A Chapman grant covering partial travel expenses will be available to one or two students who will be attending the conference. To apply, write to AGU, giving your educational background, your reasons for wanting to attend the conference, and your current interests. The awardees will be selected by AGU in conjunction with the program committee. Deadline for travel application is November 30, 1981.

Program Committee

David M. Hershfield (Chairman), U.S. Dept. Agriculture, SEA/AR, Hydrology Lab., Rm. 139, Bldg. 007, BARC-West, Beltsville, MD 20705; telephone: (Commercial) 301/344-3490, (FTS) 344-3490.

Douglas Greene, Hydrologic Research Laboratory, Office of Hydrology -OA/W23, 8060 13th St., Silver Spring, MD 20910; telephone: 301/427-7619.

S. H. Lin, Bell Laboratories, Rm. WB 1A-227, Holmdel, NJ 07733; telephone: 201/870-7445.

John L. Vogel, Atmos. Sci. Section, Illinois State Water Survey, Box 232, Urbana, IL 61801; telephone: 217/333-4261.

Arnold Court, California State University-Northridge, Northridge, CA 91330; telephone: 213/885-3521 or 3532.

John Theon, NASA Headquarters EBT-8, Washington, D.C. 20546; telephone: 202/755-8596.

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Aeronomy

[illegible]

Electromagnetics

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[illegible]

0970 Magnetic and electrical methods
TRANSIENT RESPONSE OF AN INDUCTION LOGGING TOOL IN A BOREHOLE
See 0990 Instruments
W. C. Chew (Schlumberger-Doll Research, P.O. Box 307, Ridgefield, CT 06877) F. J. Kaplin
The long time transient response is developed for a point coil transmitter (vertical magnetic dipole) located in a wellbore surrounded by a homogeneous formation. A simple algorithm is derived for the apparent conductivity signal based on the difference between the voltage nulls in a pair of receiver coils which are displaced vertically from the transmitter along the axis of the wellbore. A justification of these results is provided by means of a direct numerical integration (double Fourier transform) and also two separate approximate approaches.
GEOPHYSICS, vol. 46, no. 9

0920 Magnetic and electrical methods
MULTIFREQUENCY TURAM MEASUREMENTS OVER A SULFIDE DEPOSIT
M. Poddar (National Geophysical Research Institute, Uppal Road, Hyderabad 500 007, India)
A six-frequency electromagnetic (EM) system has been developed and used for a Turam-type survey over the sulfide deposit of Mailaram copper belt in Andhra Pradesh, India. Turam field strength ratio (FSR) and phase difference (PD) are measured in the range 84 to 2688 Hz. Sulfides in this belt occur as thin concentrated lodes which grade into disseminations. Soil covers a major part of the area. Interpretation of the results is carried out using a thin sheet model in free space. However, an attempt has been made to account for finite resistivity of the normal ground by computing Turam response of a conducting half-space appropriate for the area and subtracting the same from the observed response. The results of the survey confirm the known advantage of the Turam method, viz., its greater depth of investigation compared to a method like Slingram. The normal ground at Mailaram is only mildly conducting so that the free-air approximation is valid at low frequencies. A correction for the finite resistivity of the ground is required only at high frequencies. However, the limitation of a single-body interpretation scheme for the bedrock conductor is well brought out by the results.
GEOPHYSICS, vol. 46, no. 9

0920 Magnetic and electrical methods
A NEW TECHNIQUE FOR LAYERED EARTH MAGNETOTELLURIC INVERSION
J. C. Larsen (U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Pacific Marine Environmental Laboratory, 3711 - 15th Ave. N.E., Seattle, WA 98105)
A new one-dimensional (1-D) inverse method for layered-earth interpretation of magnetotelluric (MT) response curves is based on the method of Schmucker (1972). It involves transforming the F [illegible]

performed in central Louisiana showed that (1) distributed charges increase the signal-to-noise (S/N) ratio relative to that yielded by concentrated charges by reducing shot-generated surface noise, (2) distributed charges increase the usable frequency content over that yielded by concentrated charges, and (3) a reliable and efficient distributed charge can be constructed with Nonel Primadet delay cord.
GEOPHYSICS, v. 46, no. 9

0930 Seismic methods
RECONSTRUCTION OF A SPARSE SPIKE TRAIN FROM A PORTION OF ITS SPECTRUM AND APPLICATION TO HIGH-RESOLUTION DECONVOLUTION
See 0910 Computer applications
Shlomo Levy (Formerly Department of Geophysics and Astronomy, University of British Columbia, Vancouver; presently Mobil Oil, Special Applications, Dallas, TX 75221) Peter K. Fullagar
An algorithm is proposed for the reconstruction of a sparse spike train from an incomplete set of its Fourier components. It is shown that as little as 20–25 percent of the Fourier spectrum is sufficient in practice for a high-quality reconstruction. The method employs linear programming to minimize the L_1-norm of the output, because minimization of this norm favors solutions with isolated spikes.
Given a wavelet, this technique can be used to perform deconvolution of noisy seismograms when the desired output is a sparse spike series. Relative reliability of the data is assessed in the frequency domain, and only the reliable spectral data are included in the calculation of the spike series. Equations for the unknown spike amplitudes are solved to an accuracy compatible with the uncertainties in the reliable data. In examples with 10 percent random noise, the output is superior to that obtained using conventional least-squares techniques.
GEOPHYSICS, vol. 46, no. 9

0930 Seismic methods
ERROR ESTIMATES FOR INVERSE MODELING SCHEMES USING SEISMIC TRAVELTIMES
See 0910 Computer applications
Bjørn Ursin (SINTEF, Division of Petroleum Technology, N-7034, Trondheim-NTH, Norway)
Different methods for estimating parameters in a layered geologic model are discussed. Traveltime parameters, estimated from seismic data, are used to estimate the layer parameters defining the velocity function in each layer and the interfaces between the layers.
Seismic measurement data are assumed to consist of a sum of nonoverlapping reflected pulses and additive white Gaussian noise. An estimate of the covariance of the traveltime parameters is then given by the inverse of Fischer's information matrix. It is shown how the information matrix can be computed theoretically or directly from data. Expressions for the covariance matrix of the layer parameters are given. [illegible]

Geochemistry

[illegible]

to the model projections, the concentration of tropospheric nitrous oxide in the year 2000 will be 5 to 7% above present values. The observed rate of tropospheric increase directly affects the production of stratospheric nitric oxide, and plays a significant role in the earth's radiation balance, conservatively estimated as 10–15% of the effect due to increasing carbon dioxide. (Nitrous oxide, atmosphere, anthropogenic sources).
J. Geophys. Res., Green, Paper 1C0917

1610 Chemistry of the atmosphere
THE DETERMINATION OF TROPOSPHERIC NITROUS OXIDE
R. F. Weiss (Scripps Institution of Oceanography, A-020, University of California, San Diego, La Jolla, California, 92093, U.S.A.) C. D. Keeling and H. Craig
A two-step technique, in which the N_2O/CO_2 ratio is measured by ultrasonic phase-shift gas chromatography and the dry air CO_2 concentration is measured by non-dispersive infrared analysis, has been developed for the determination of the mole fraction of nitrous oxide in dry air. The N_2O concentration is given by the product of these two independent measurements and has a precision (± one standard deviation) ranging between 0.3 and 0.5%. The absence of systematic errors has been verified by extensive standard intercomparisons and by independent cross-checks of the sample extraction procedures. The results of extensive measurements by this technique, reported in a companion paper, fix the mean tropospheric dry air mole fraction of nitrous oxide in the northern hemisphere as of 1 January 1978 at 300.2 ± 0.6 parts per billion, including systematic uncertainties. (Nitrous oxide, gas chromatography, calibrations).
J. Geophys. Res., Green, Paper 1C0916

1640 Chemistry of the solid earth
OXYGEN ISOTOPE RATIOS OF ICELANDIC CRUST
K. Hattori (Department of Geology and Geophysics, University of Calgary, Calgary, Alberta, T2N 1N4 Canada) K. Muehlenbachs
Oxygen isotope ratios of hydrothermally altered basalts from depths up to 3 km are reported from 3 localities in Iceland: (i) Tertiary International Research Drilling Project site in eastern Iceland; whole rock $\delta^{18}O$, +6.4 to +2.4‰ SMOW, (ii) Plio-Pleistocene basalt from Reykjavik, +4.3 to +0.8‰, (iii) Holocene basalt from Krafla central volcano, −3.4 to −10.5‰. The values in the deeper portion at Krafla are the lowest ever reported. All the samples were affected by meteoric hydrothermal activity at 300 to 400°C with different water/rock ratios. The effective circulation of meteoric water at Krafla has caused strong subsolidus depletion of ^{18}O.
The primary magma of the I.R.D.P. core had $\delta^{18}O$ of +3.9‰. Such low-^{18}O magmas are common in Iceland since Tertiary and the depletion of ^{18}O at liquidus condition may have occurred as the result of oxygen isotope exchange with or assimilation of low-^{18}O altered rocks, which form a thick sequence beneath the island due to isostatic subsidence (Oxygen isotope, alteration, Iceland, basalt).
J. Geophys. Res., Red, Paper 1B1014

1699 General or miscellaneous
CONSTRAINTS ON WATER TRANSPORT AND ALTERATION IN THE OCEANIC CRUST FROM THE ISOTOPIC [illegible]

Hydrology

[illegible]

addition natural ice in glaciers appears stronger than natural ice deformed in the laboratory. These observations suggest either that the stress is systematically overestimated in field studies, or that a flow law based on the von Mises yield criterion (or second invariant of the stress deviator tensor) does not provide an adequate description of the deformation of ice in multiaxial stress fields.
Rev. Geophys. Space Phys., Paper 1R0924

3175 Soil moisture
DESCRIPTION OF EQUILIBRIUM CHEMISTRY DURING TRANSIENT SOLUTE TRANSPORT
L. H. Dudley, R. J. Wagenet (Dept. Soil Science and Biomet., Utah State Univ., Logan, UT 84322), and J. J. Jurinak.
A field experiment was conducted to assess the reliability of a soil-water and equilibrium chemistry simulation model. The deterministic model considers one-dimensional water flow and solute transport represented by the Darcy equation and miscible displacement theory. Soil chemical reactions include the precipitation and dissolution of lime and gypsum, and also cation exchange. It was determined that the model provided reasonably accurate simulation of electrical conductivity during transient transport under cropped situations, and was less accurate in non-cropped cases. This was attributed to an apparent homogenization of water and solute flows by the activity of plant root extraction. This indicates that the use of single-valued relationships in this model to describe water and solute flow is an acceptable practice to describe cropped cases, but that other modeling approaches should be developed for non-cropped cases. (Simulation models, spatial variability, solute flow).
Water Resour. Res., Paper 1W0980

3180 Water quality
METHODS OF DISCHARGE COMPENSATION AS AN AID TO THE EVALUATION OF WATER-QUALITY TRENDS
D. Harned (U.S. Geological Survey, P.O. Box 2857, Raleigh, North Carolina, 27602, U.S.A.) C. Daniel III, J. Crawford
Two new methods for compensating for discharge when evaluating trends in water-quality data use long-term discharge records as the base for data adjustment. One method, discharge normalization, adjusts daily discharges using a central value calculated for the period of record, and recalculates daily specific conductance from the adjusted discharges and discharge versus specific conductance regressions. Normalized concentrations for many constituents can then be calculated from linear relationships between specific conductance and constituent concentrations. The second method, discharge-frequency weighting, weights each observed concentration by a fraction of the total area underneath the discharge-frequency distribution for the period of record. This fraction is determined using the stream discharge at the time of sampling and the discharge-frequency distribution for the period of record. The weighted concentrations are summed for each year. Both normalized values and weighted values can be plotted against time to produce trends essentially independent from discharge effects. Results from the methods are statistically similar to each other and to results from other trend-detection techniques. (Trends, time series analysis, flow adjustment).
Water Resour. Res., Paper 1W0910

[illegible]

Meteorology

[illegible]

Latest Releases from AGU

The Tectonic and Geologic Evolution of Southeast Asian Seas and Islands, (1980) Dennis E. Hayes, editor, illustrated, foldout map, 334 pages, $25.00, (GM2300).

A cooperative research endeavor between earth scientists in the United States and their counterparts in Southeast Asia continuing the scientific objectives of the 'Studies of East Asian Tectonics and Resources' (SEATER) program. Seismically active marginal and back-arc basins are explored with a focus on aerial land geology. Closely related materials will be found also in the Maurice Ewing Series books.

Derivation, Meaning, and Use of Geomagnetic Indices, (1980), P. N. Mayaud, illustrated, 36 tables, referenced and indexed, 160 pages, hardcover, $20.00 (GM2200).

Mayaud first answers the question, what is a geomagnetic index? Then gives: an historical review of the main indices used in the past and describes the three classes of indices officially recognized by the IAGA at present. This book will aid workers to use the geomagnetic indices and give an understanding of their meaning and of the way in which they are derived. An important and lasting reference tool.

Earthquake Prediction: An International Review, (1981), edited by David W. Simpson and Paul G. Richards. Illustrated, color plates, 688 pages, clothbound, $29.00, (ME0400).

The understanding of plate tectonics have propelled scientists from a host of disciplines to greater challenges. Earthquake prediction provides a sharp focal point for combining classical methods of geology with emerging technology, and analytical techniques in the earth sciences. Earthquake prediction and the ultimate prospect of exploiting this capability to reduce human suffering is the recognized goal. The 51 papers in this volume discuss exciting current developments in international research and lay the foundation for continuing investigations.

Mechanical Behavior of Crustal Rocks (1981) edited by N. L. Carter, M Friedman, J. M. Logan, and D. W. Sterns. Illustrated, 336 pages, clothbound, $32.00, (GM2400).

Dedicated to John Handin, this volume serves as an up-to-date reference book for all researchers concerned with the following topics: Earthquake mechanics; geothermal energy recovery; energy storage and waste isolation; experimental rock mechanics and rock rheology; geological, geophysical, engineering, and mining rock mechanics.

Paleoreconstruction of the Continents, (1981), edited by M. W. McElhinny and D. A. Valencio. Illustrated, 200 pages, clothbound, $15.00 (Geod. 0200). Volume 2 of the new Geodynamics Series.

This important book analyzes evidence leading to the reconstruction of past configurations of continental blocks. Includes new interpretations of data describing the distribution of plates in the Paleozoic Era; horizontal movements of the lithosphere; and plate movements associated with earthquakes, volcanism, thermal gradients; and the morphology of the sea-floor and orogenic belts.